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## NOTICE TO
## FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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### EXHIBITS


Flood Profiles

Elkhorn River — Panel 01P

Flood Boundary and Floodway Map Index
Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map


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FLOOD INSURANCE STUDY

CITY OF HOOPER,
DODGE COUNTY,
NEBRASKA

## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Hooper, Dodge County, Nebraska, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

### 1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by Henningson, Durham & Richardson (HDR) (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Contract No. H-4733. This work was completed in July 1980.

In conjunction with a revised study for Dodge County, Nebraska, the U.S. Army Corps of Engineers (COE), Omaha District, also performed detailed hydrologic and hydraulic analyses on the flooding source affecting the City of Hooper. The COE analyses were based on the levee at Hooper holding, contrast to the HDR analyses, which were based on the levee failing.

This study utilizes the previous work completed by HDR in July 1980, but incorporates all changes resulting from the COE analyses considering the levee holding. This additional work performed by the COE was completed in March 1985.

### 1.3 Coordination

Community base map selection and the identification of streams requiring approximate study were done in meetings attended by personnel of the Study Contractor, FEMA, and the officials of the City of Hooper in April 1976.

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The following institutions, organizations, or individuals were contacted for coordination and information acquisition: the Nebraska Natural Resources Commission, the Lower Elkhorn Natural Resources District, the Missouri River Basin Commission, the COE, the U.S. Soil Conservation Service (SCS), the U.S. Geological Survey (USGS), and the Regional Planning Agency ENCOG.

During the course of the work by the Study Contractor, flood boundaries were reviewed with community officials. On June 15, 1978, an intermediate meeting was held in the City of Hooper. The results of the approximate study were presented to the city officials for review and comments. Detailed study was requested by FEMA in September 1979.

On February 4, 1986, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Hooper, Dodge County, Nebraska, and its 1-mile extraterritorial jurisdiction. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of the Elkhorn River was studied in detail within the extraterritorial limits.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through March 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Hooper.

### 2.2 Community Description

The City of Hooper is located in the extreme east-central part of Nebraska in east-central Dodge county and is bordered on its eastern extraterritorial limits by the extraterritorial limits of the City of Winslow, Nebraska, and on all other sides by unincorporated areas of Dodge County. The City of Hooper is serviced by Interstate 275 and the Chicago and North Western Railroad. The 1980 population of Hooper was reported to be 932 (Reference 1).

The City of Hooper is located 25 miles northwest of the City of Fremont, 54 miles northwest of the City of Omaha, 7 miles northwest of the City of Scribner, and 6 miles east of the Village of Dodge. The economy of the area is mainly agricultural with the city serving as a local business area for the surrounding rural area.

Dodge County contains three distinct topographic regions including the valley, rolling hills, and plains regions. The valley is a region of low relief along major streams. Valleys occur along the Elkhorn and Platte Rivers. The northwestern and northeastern portions of the county are classified as rolling hills. These are land forms consisting of a series of ridges and valleys. They were formed by continental glacial ice features modified by erosion and deposition of material. The plains are composed of relatively



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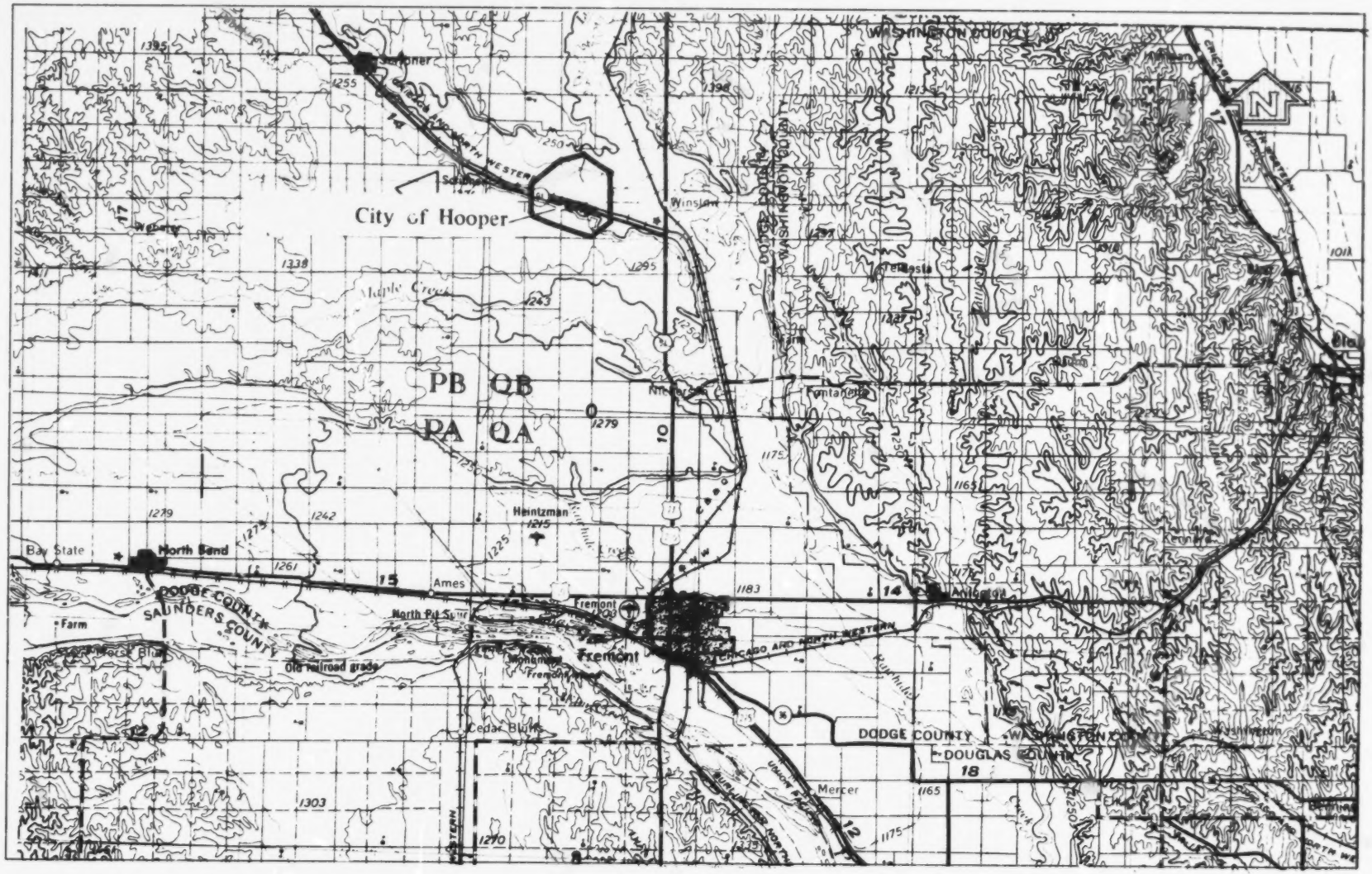
City of Hooper
PB QB
PA QA
Winslow
Fontanelle
Heintzman
Bay State
North Bend
Ames
Fremont
Farm
SAUNDERS COUNTY
DODGE COUNTY
DOUGLAS COUNTY
Old railroad grade
Cedar Bluffs
Mercer
Arlington
Maple Creek
1279
1242
1261
1303
1270
1183
1165
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flat uplands underlain with sand, sandstone, or gravelly sand. Soils have formed on a wind-deposited mantle of silt (loess). The Luton-Haynie Soil Association is found in the Elkhorn River Valley. This type of soil is usually a loam with slow surface drainage. The most prominent soil association is the Moody-Crofton Association. The soils were generally developed in the Wisconsinan-Age and are a loess (Reference 2).

The climate of the area is typical of the Midwest, with cold winters and hot summers. The average precipitation in the area is approximately 28.5 inches. The temperature ranges from an average of 24 degrees Fahrenheit (°F) in January to an average of 67°F in July. The snowfall season normally extends from October through April. The average annual gross lake evaporation is 41 inches. Vegetation in the area consists of row crops, small grains, hay crops, pastureland, small stands of timber, and miscellaneous plants. Native vegetation is limited to fence rows, channels, and road ditches (Reference 3).

The Elkhorn River is the fourth largest tributary of the Platte River. It is formed by the confluence of South Fork and Middle Fork Elkhorn Rivers about 1 mile east of the Village of Ewing. The drainage area of the Elkhorn River at Hooper is approximately 4,859 square miles. The Elkhorn River discharges into the Platte River south of Omaha.

Mainly agricultural and some residential development exists in the Elkhorn River flood plain within the extraterritorial limits of Hooper.

## 2.3 Principal Flood Problems

The northern part of Hooper is subject to flooding from overflow of the Elkhorn River. The flood of 1944 is the flood of record on the Elkhorn River and has a return frequency of greater than 100 years. During this flood, the entire city was underwater. Floods at Hooper are summarized below.

FLOODS OF THE ELKHORN RIVER

| Year | Discharge* | Cause |
|---|---|---|
| 1873 | N/A[1] | N/A |
| July 1902 | N/A | rain |
| March 1912 | N/A | snowmelt and ice jams |
| June 1944 | 100,000 | rain and Pebble Creek overflow |
| March 1960 | 46,900 | snowmelt and ice jams |
| March 1962 | 50,200 | snowmelt and ice jams |
| June 1967 | 39,600 | rain |
| February 1971 | 41,700 | snowmelt and ice jams |

*cubic feet per second (cfs)

[1]information not available

The Elkhorn River has been estimated by the COE to have a channel capacity of 24,500 cfs at Hooper.

Floods from the Elkhorn River and its tributaries are usually caused by intense thunderstorms with heavy rainfall occurring over the basin in a short period. Snowmelt and ice jams also cause flooding problems along the Elkhorn River and its tributaries (Reference 3).



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## 2.4 Flood Protection Measures

A levee has been constructed around the low-lying areas of Hooper. This levee provides protection from the 100-year flood. The COE has prepared a detailed project report for the levee (Reference 4). The criteria used to evaluate protection against the 100-year flood are 1) adequate design, including freeboard, 2) structural stability, and 3) proper operation and maintenance. Levees that do not protect against the 100-year flood are not considered in the hydraulic analysis of the 100-year flood plain.

# 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

## 3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Streamflow records for the USGS gage on the Elkhorn River at the Waterloo, Nebraska, gage (No. 06800500) are available for the period 1929 through 1975 (Reference 5). There are 2 years during this period where no peak flows are available in the published record. A frequency analysis was performed on the remaining 45-year annual series record using the log-Pearson type III method as described in U.S. Water Resources Council Bulletin No. 15 (Reference 6). The results have been adjusted for regional effects and other long-term gaging stations in the area and agree closely with the calculated results for the Waterloo station, suggesting that the Waterloo data are representative of the region. The results of the frequency analysis, using a skew of 0.276, were almost identical to the results in the Platte River Level B Study (Reference 7).

A regional frequency analysis was then done to determine the design flows in the reaches upstream of Waterloo. The regional frequency analysis was performed using the following gages (Reference 5):



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| Gage | Years of Record |
|---|---|
| Elkhorn River near Norfolk (No. 06799000) | 1946-80 |
| Elkhorn River near Neligh (No. 06798500) | 1932-80 |
| Elkhorn River near Ewing (No. 06797500) | 1947-80 |
| Logan Creek near Uehling (No. 06799500) | 1941-80 |
| Maple Creek near Nickerson (No. 06800000) | 1952-75 |

The results of the regional frequency analysis were again compared to the Platte River Level B Study giving excellent agreement.

Therefore, the values of the 10-, 50-, and 100-year flood discharges on the Elkhorn River were taken from the Platte River Level B Study (Reference 7). Values for the 500-year flood discharges were taken from curves plotted through the 10-, 50-, and 100-year values published in the Platte River study.

Peak discharges for the 10-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (SQ MILES) | PEAK DISCHARGE (CFS) 10-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|
| ELKHORN RIVER at Hooper | 2,869* | 26,900 | 69,900 | 118,000 |

*drainage area contributing to peak discharge

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Analyses were performed also for conditions under which ice jams occur.

Since the COE hydraulic analyses supersede the previous HDR hydraulic analyses, only information relative to the COE analyses is presented in this report.

Cross sections on the Elkhorn River were obtained in 1982 by field survey methods from Nickerson to the Dodge-Cuming county line (Reference 8).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map.

Roughness coefficients (Manning's "n") for the overbanks and channel of the Elkhorn River were established by field inspection and engineering judgment. The Manning's "n" values for the Elkhorn River were set at 0.032 for the channel and ranged from 0.050 to 0.100 for the overbanks.

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Water-surface profiles were developed using the HEC-2 step-backwater computer model (Reference 9). The starting water-surface elevations were determined from normal depth computations by the slope-area method.

Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals. In cases where the 50- and 100-year flood elevations are close together, due to limitations of the profile scale, only the 100-year profile has been drawn.

Areas of the community protected by the levee are subject to potential risk due to possible failure or overtopping of the levee. These areas were delineated by applying the 500-year elevation determined from the "without levee" analysis.

The hydraulic analyses for this study are based on the effects of ice obstructed flow. The flood elevations shown on the profiles are considered valid only if hydraulic structures operate properly and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

## 4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.

### 4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:4800 with a contour interval of 10 feet (Reference 10).

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map. In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

Some areas of the community that are protected from the 100-year flood by a levee have been delineated as having potential risk due to possible failure or overtopping of the levee during larger floods.

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## 4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was computed and are presented in Table 2, Floodway Data.

As shown on the Flood Boundary and Floodway Map, the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and the 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway of the Elkhorn River lie outside the extraterritorial limits.

The area between the floodway and the 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

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| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQ. FEET) | MEAN VELOCITY (FEET/SEC.) | REGULATORY (FEET NGVD) | WITHOUT FLOODWAY (FEET NGVD)[3] | WITH FLOODWAY (FEET NGVD) | INCREASE (FEET) |
| ELKHORN RIVER | | | | | | | | |
| A | 52,520 | 5250[2] | 38,866 | 1.8 | 1222.1 | 1221.3 | 1222.1 | 0.8 |
| B | 58,030 | 5685[2] | 30,598 | 2.3 | 1223.2 | 1222.5 | 1223.4 | 0.9 |
| C | 63,580 | 4150[2] | 27,675 | 2.5 | 1224.8 | 1224.1 | 1225.0 | 0.9 |
| D | 64,920 | 2750 | 16,907 | 4.1 | 1225.3 | 1224.6 | 1225.5 | 0.9 |
| E | 65,940 | 2650 | 16,058 | 4.4 | 1226.3 | 1225.7 | 1226.4 | 0.7 |
| F | 67,290 | 2650 | 26,652 | 2.6 | 1229.2 | 1228.6 | 1229.2 | 0.6 |
| G | 68,700 | 3350 | 28,889 | 2.4 | 1229.5 | 1228.8 | 1229.7 | 0.9 |
| H | 70,470 | 4600 | 30,319 | 2.3 | 1229.9 | 1229.2 | 1230.2 | 1.0 |
| I | 71,920 | 5150[2] | 20,022 | 3.5 | 1230.6 | 1229.9 | 1230.8 | 0.9 |
| J | 73,120 | 6170[2] | 22,295 | 3.1 | 1231.7 | 1231.0 | 1231.8 | 0.8 |

[1]FEET ABOVE STATE HIGHWAY 91
[2]THIS WIDTH EXTENDS BEYOND EXTRATERRITORIAL LIMITS
[3]ELEVATION WITHOUT CONSIDERING ICE JAM EFFECTS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF HOOPER, NE

(DODGE CO.)

FLOODWAY DATA

ELKHORN RIVER

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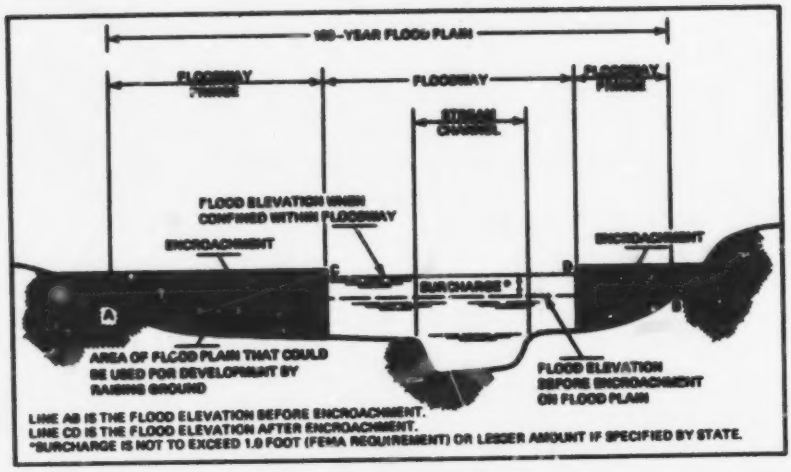
100-YEAR FLOOD PLAIN
FLOODWAY
FLOODWAY
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
SURCHARGE*
A
B
C
D
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT.
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT.
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FIGURE 2 - Floodway Schematic

The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

## 5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail affecting the City of Hooper.

### 5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the weighted average difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following table for more than 20 percent of the reach:

| Average Difference Between 10- and 100-year Floods | Variation |
|---|---|
| Less than 2 feet | 0.5 foot |
| 2 to 7 feet | 1.0 foot |
| 7.1 to 12 feet | 2.0 feet |
| More than 12 feet | 3.0 feet |

The locations of the reaches determined for the riverine flooding sources of the City of Hooper are shown on the Flood Profiles and are summarized in Table 3, Flood Insurance Zone Data.



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## 5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a riverine reach is the weighted average difference between the 10- and 100-year flood water-surface elevations rounded to the nearest 0.5 foot, multiplied by 10, and shown as a 3-digit code. For example, if the difference between elevations is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference is greater than 10.0 feet, it is rounded to the nearest whole foot.

## 5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

| | |
|---|---|
| Zone A2: | Special Flood Hazard Areas inundated by the 100-year flood, with base flood elevations shown, and zones subdivided according to FHFs. |
| Zone B: | Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- and 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and, areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding; not subdivided. |

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the community are shown in Table 3, Flood Insurance Zone Data.

## 5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Hooper is, for insurance purposes, the principal product of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines for riverine flooding sources show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.



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| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FLOOD HAZARD FACTOR | ZONE | BASE FLOOD ELEVATION[3] (FEET NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10-YEAR) | 2% (50-YEAR) | 0.2% 500-YEAR) | | | |
| ELKHORN RIVER REACH 1 | 0002,0004 | −1.0 | −0.3 | 2.1 | 010 | A2 | VARIES—SEE MAP |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF HOOPER, NE

(DODGE CO.)

FLOOD INSURANCE ZONE DATA

ELKHORN RIVER

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## 6.0 OTHER STUDIES

Flood Insurance Studies have been published for both the Village of Winslow and the Unincorporated Areas of Dodge County (References 11 and 12).

This report incorporates a revised analysis for the Elkhorn River, which raised the profile and therefore does not agree with the above-mentioned studies. However, a revision is in progress for the Flood Insurance Study for Dodge County (Reference 12) and is in agreement with this study.

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Hooper (Reference 13).

## 7.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, Old Federal Office Building, Room 300, 911 Walnut Street, Kansas City, Missiouri 64106.

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U.S. Army Corps of Engineers, Plan and Study, Platte River and Tributaries, 1976, not approved.



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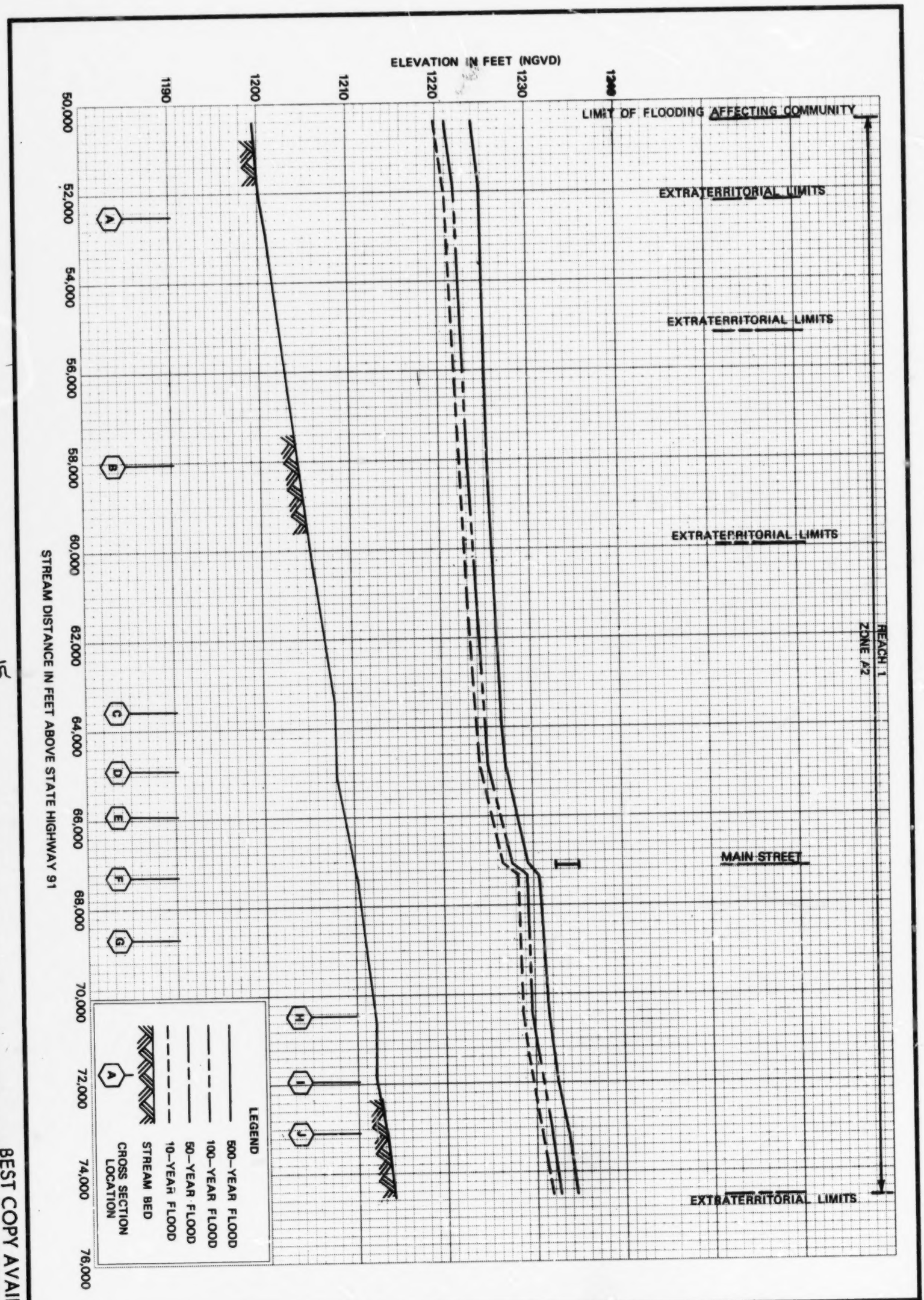


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